## CLAIMS

What is claimed is:

1. A thermal process for treating a metal to improve structural characteristics of the metal comprising:

    a. placing a metal with a metal temperature within a thermal control apparatus comprising a chamber with a chamber temperature;

    b. introducing a cryogenic material into the thermal control apparatus to decrease the metal temperature, while preventing over-stressing of the metal, to a first target temperature ranging from -40 degrees F and -380 degrees F at a first temperature rate ranging from 0.25 degrees per minute and 20 degrees per minute;

    c. stopping the introduction of the cryogenic material into the chamber once the first target temperature is reached;

    d. increasing the chamber temperature to a second target temperature ranging from 0 degrees F and 1400 degrees F; and

    e. increasing the metal temperature to the second target temperature at a second temperature rate ranging from 0.25 degrees per minute and 20 degrees per minute, resulting in a treated metal without fractures.

2. The thermal process of claim 1, wherein the first temperature rate is different from the second temperature rate to create a desired metallurgical feature in the treated metal without fractures, wherein the desired metallurgical feature is selected from the group consisting of malleability, flexibility, ductility, hardness, elasticity, strength, and combinations thereof.

3. The thermal process of claim 1, wherein the first temperature rate is substantially the same as the second temperature rate.

4. The thermal process of claim 1, further comprising the steps of:

a. introducing a cryogenic material into the thermal control apparatus to decrease the metal temperature, while preventing over-stressing of the metal, to a third target temperature at a third temperature rate, wherein the third target temperature is colder than the first target temperature;

b. stopping the introduction of the cryogenic material into the chamber once the third target temperature is reached;

c. increasing the chamber temperature to a fourth target temperature; and

d. increasing the metal temperature to the fourth target temperature at a fourth temperature rate, resulting in the treated metal without fractures.

5. The thermal process of claim 4, further comprising the steps of:

a. introducing a cryogenic material into the thermal control apparatus to decrease the metal temperature, while preventing over-stressing of the metal, to a fifth target temperature at a fifth temperature rate;

b. stopping the introduction of the cryogenic material into the chamber once the fifth target temperature is reached;

c. increasing the chamber temperature to a sixth target temperature; and

d. increasing the metal temperature to the sixth target temperature at a sixth temperature rate, resulting in the treated metal without fractures.

6. The thermal process of claim 5, further comprising repeating the steps at least four times.

7. The thermal process of claim 1, further comprising the step of permitting the metal to soak at the first target temperature for a first period of time.

8. The thermal process of claim 7, wherein the first period of time ranges from 15 minutes to 96 hours.

9. The thermal process of claim 1, further comprising the step of permitting the metal to soak at the second target temperature for a second period of time.

10. The thermal process of claim 9, wherein the second period of time ranges from 15 minutes to up to 48 hours.

11. The thermal process of claim 1, wherein the thermal process is repeated to create a second desired metallurgical feature in the treated metal without fractures, wherein the second desired metallurgical feature is selected from the group consisting of malleability, flexibility, ductility, hardness, elasticity, strength, and combinations thereof.

12. The thermal process of claim 1, wherein the thermal control apparatus further comprises a heat exchanger disposed in the chamber to provide a cryogenic vapor to the tank.

13. The thermal process of claim 12, wherein the cryogenic material is released into the heat exchanger thereby absorbing heat from the chamber into the heat exchanger forming a cryogenic vapor that fills the tank.

14. The thermal process of claim 12, wherein the cryogenic vapor is a member of the group consisting of hydrogen, nitrogen, oxygen, helium, argon, and combinations thereof.

15. The thermal process of claim 1, wherein the first temperature rate and the second temperature rate are determined by the mass of the metal.

16. The thermal process of claim 4, wherein the third temperature rate and the fourth temperature rate are determined by the mass of the metal.

17. The thermal process of claim 5, wherein the fifth temperature rate and the sixth temperature rate are determined by the mass of the metal.

18. The thermal process of the claim 1, wherein the chamber is selected from the group consisting of a double-walled insulated chamber, a vacuum chamber, and a vacuum-insulated chamber.

19. The thermal process of claim 1, wherein the metal is selected from the group consisting of a bronze, a cobalt, a silver, a silver alloy, a nickel, a nickel alloy, a chromium, a chromium alloy, a vanadium, a vanadium alloy, a tungsten, a tungsten alloy, a titanium, a titanium alloy, a scandium, a scandium alloy, a tin, a platinum, a palladium, a gold, a gold alloy, a plated metal, a lead, a plutonium, an uranium, a zinc, an iron, an iron alloy, a magnesium, a magnesium alloy, a gallium, a gallium arsenide, a selenium, silicon, calcium, calcium fluoride, fused silica materials, germanium, indium, indium phosphide, phosphorous and combinations thereof.

20. The thermal process of claim 1, wherein the metal is a laminate.

21. The thermal process of claim 20, wherein the laminate is disposed on a member of the group consisting of a ceramic, a wood, a polymer, and combinations thereof.

22. The thermal process of claim 1, wherein the metal is a ceramet.

23. The thermal process of claim 4, wherein the metal is a metal carbide.